

5 TITLE OF THE INVENTION

ELECTRIC DRIVE DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to DE 102 42 833.6, which was filed  
September 14, 2002, the contents of which are incorporated by reference in their  
10 entirety.

BACKGROUND OF THE INVENTION

The invention concerns an electric drive device.

A large number of electric drive devices are known on the basis of the  
state of the art. Hence, one distinguishes direct current motors from three phase  
15 current motors and synchronous motors from asynchronous motors on the basis  
of the state of the art.

The so-called transverse flow motor represents a completely new concept  
for such an electric drive device in comparison with the previously common  
electric drive devices. Transverse flow motors allow optimizing important  
20 characteristics of electric drive devices, namely achieving a compact  
construction, restricting the mass and therewith the weight, as well as  
simultaneously guaranteeing a high power density and therewith higher  
efficiency of the electric drive device.

SUMMARY OF THE INVENTION

25 The present invention concerns the area of transverse flow motors.

The present invention is based upon the problem of creating an improved  
electric drive device, namely an improved transverse flow motor.

This problem is solved by an electric drive as described within the  
specification and claims.

30 Preferred refinements of the invention emerge from the specification and  
claims.

5 BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1: Illustrates a schematized representation of an electric drive device according to the state of the art in a partially broken up, perspective side view.

Fig. 2: Illustrates a detail of the electric drive device according to the state of the art in accordance with Fig. 1, likewise in perspective side view.

Fig. 3: A strongly schematized representation of an electric drive device within the sense of the invention with a compressor blade fastened on a rotor of the electric drive device.

Fig. 4: A strongly schematized representation of a rotor of the electric drive device of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 shows an electric drive device according to the state of the art constructed as a transverse flow motor 10. The transverse flow motor 10 illustrated there includes a cylindrically constructed stator 11 and a cylindrically constructed rotor 12, whereby the rotor 12 is arranged outside the stator 11. In other words, the outer rotor 12 surrounds the internal stator 11. An object 13 to be driven by the transverse flow motor 10, e.g., a wheel or a turbine blade, is directly connected with the rotor 12.

Three phases 14, 15 and 16 are arranged alongside one another in the transverse flow motor 10 represented in Figure 1 so that a (not represented) converter can be used for three phase current.

Figure 2 clarifies the operating principle underlying the transverse flow motor 10 on the example of phase 14, 15 or 16. The magnetic flow is visualized by flow lines. Thus Figure 2 depicts one of phases 14, 15 or 16 consisting of rotor 12 and stator 11. The stator 11 encloses several U-shaped constructed stator blades 17 arranged at a distance from one another, whereby the stator blades 17

5 are surrounded by current-carrying windings 18, or surround such. The stator blades 17 of each phase 14, 15 and 16 form a cylindrical ring (see Figure 1).

Permanent magnets 19, 20 of the rotor 12 are constructed with alternating polarity. That is, a permanent magnet 20 respectively constructed as North Pole is arranged between two permanent magnets 19 respectively constructed as  
10 South Pole. In accordance with Figure 2, a respectively annularly or cylindrically constructed rotor element 23, 24 of the rotor 12 with polarity alternating permanent magnets 19, 20 is arranged adjacent to the two opposed pole ends 21, 22 of the U-shaped stator blades 17. Each phase 14, 15 or 16 of the transverse flow motor 10 is accordingly allocated two such rotor elements 23, 24,  
15 in each case one in the region of one of the pole ends of the U-shaped stator blades 17.

Furthermore, in accordance with Figure 2, respectively one permanent magnet 19, 20 with likewise alternating polarity is also allocated to the two opposed pole ends 21, 22 of a single stator blade 17. From this it follows first  
20 that two adjacent permanent magnets 19, 20 of rotor element 23 or 24 have a different polarity within a single rotor element 23 or 24 which extends in the region of a pole end of stator blade 17. Second, opposed permanent magnets 19, 20 which are allocated to opposite pole ends 21, 22 of a stator blade 17 are constructed differently in their polarity.

25 To complete the magnetic flow and therewith to increase the degree of efficiency, a respectively I-shaped constructed stator element 25 is arranged between two U-shaped constructed stator blades 17 in each case. Nonetheless, it is possible to dispense with the stator elements 25 even with a slightly modified construction principle.

30 As can be inferred from Fig. 1 in particular, the hollow space between adjacent stator blades 17 is filled by segments 26 of non-magnetic material, on

5 the one hand to obtain a stable construction, and on the other not to impair the magnetic flow. The segments 26 project radially out of a likewise non-magnetic cylindrical foundation 27.

With the transverse flow motor 10, the flow is accordingly guided into the stator blades 17 perpendicular to the direction of motion or parallel to the axis of  
10 rotation of the rotor 12. The windings 18 in contrast run in the direction of motion of the rotor. The cross sections of the windings 18 and the stator blades 17 can be selected independently of each other. From this, there results a small realizable phase spacing through which a high degree of efficiency can be attained with winding losses remaining constant.

15 Henceforth an electric drive device constructed as a transverse flow motor 28 is being proposed within the meaning of the invention as it is illustrated in Figures 3 and 4. Figures 3 and 4 clarify the electric drive device of the invention with reference to the example of a phase 29, whereby even here, as with the state of the art in accordance with Figures 1 and 2, a total of three phases can be  
20 present.

In accordance with Figure 3, the phase 29 of the transverse flow motor 28 shown there once again includes a stator 30 and a rotor 31. As distinct from the state of the art, the stator 30 of the transverse flow motor 28 of the invention nonetheless has available two cylindrical rings 32, 33 of U-shaped stator blades  
25 34 arranged on both sides of the rotor 31, whereby the stator blades 34 are once again surrounded by current-carrying windings 35, or else surround such.

The disk or ring-like constructed rotor 31 is accordingly included or enclosed by the likewise annular constructed stator 30 such that respectively one of the two rings 32, 33 of U-shaped stator blades 34 is arranged to one side of the  
30 rotor 31.

The rotor 31 once again has annularly or cylindrically constructed rotor

5 elements 36, 37 arranged at the opposite pole ends of the U-shaped stator blades 34 with polarity-alternating permanent magnets 38, 39. As distinct from the state of the art in accordance with Figures 1 and 2, each of the rotor elements 36, 37 includes not only one ring of polarity-alternating permanent magnets 38, 39, but rather two rings of polarity-alternating permanent magnets 38, 39.

10 Opposed permanent magnets 38, 39 of opposed rotor elements 36, 37 have an alternating polarity (North Pole, South Pole). Furthermore, adjacent permanent magnets 38, 39 of the two adjacent rings inside a rotor element 36 or 37 have an alternating polarity. Furthermore, adjacent permanent magnets 38, 39 inside a ring or a rotor element 36 or 37 have available an alternating  
15 polarity.

The rotor 31 of the transverse flow motor 28 of the invention accordingly disposes over two rotor elements 36 or 37 in the region of a phase 29 which both are surrounded by the two cylindrical rings 32, 33 of the U-shaped stator blades 34 of this phase 29. In each case, one of the two rotor elements 36 or 37 is  
20 arranged between opposite pole ends of opposed stator blades 34. Each rotor element 36 or 37 has available two rings of permanent magnets 38, 39 (see Figure 3).

Due to this configuration of rotor 31 and stator 30 of the invention, a greater power density of the transverse flow motor can be attained with a  
25 constant compact construction. Even at a constant power density, once again a reduction in weight of the transverse flow motor can be achieved in relation to the state of the art. In addition to this, a redundancy with respect to the current-carrying windings is created that is especially of importance for applications in aeronautical engineering.

30 In accordance with Figures 3, 4, additional permanent magnets 40, 41 may be arranged on the one hand about the U-shaped stator blades 34 of the

5 stator 30 and on the other hand about the permanent magnets 38, 39 of the rotor 31 which serve for magnetic centering of the rotor 31. Also due to this, the construction can once again be compressed. The stator 30 may be spring-mounted through spring elements 43. Arising centrifugal forces may be absorbed with slight mechanical bracing.

10 In accordance with Figure 3, an object 42 to be driven, a turbine blade of a high pressure compressor may be arranged at one end of the rotor 31.

The design of the invention for an electrical drive device may equally be used in a motor operation and in a generator operation.

15 The use of the design of the invention in aeronautical engineering is especially advantageous, where a weight saving and a high power density are of particular interest. An electric drive device of the invention can, for example, be used for the electric starting of an aircraft propulsion unit or for the provision of an aircraft with electricity or for any other suitable application.

20 The foregoing disclosure has been set forth merely to illustrate the invention and is not intended to be limiting. Since modifications of the disclosed embodiments incorporating the spirit and substance of the invention may occur to persons skilled in the art, the invention should be construed to include everything within the scope of the appended claims and equivalents thereof.

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September 14, 2002, the contents of which are incorporated by reference in their  
10 entirety.

BACKGROUND OF THE INVENTION

The invention concerns an electric drive device ~~in accordance with the~~  
~~preamble of patent Claim 1.~~

A large number of electric drive devices are known on the basis of the  
15 state of the art. Hence, one distinguishes direct current motors from three phase  
current motors and synchronous motors from asynchronous motors on the basis  
of the state of the art.

The so-called transverse flow motor represents a completely new concept  
for such an electric drive device in comparison with the previously common  
20 electric drive devices. Transverse flow motors allow optimizing important  
characteristics of electric drive devices, namely achieving a compact  
construction, restricting the mass and therewith the weight, as well as  
simultaneously guaranteeing a high power density and therewith higher  
efficiency of the electric drive device.

25 SUMMARY OF THE INVENTION

The present invention concerns the area of transverse flow motors.

The present invention is based upon the problem of creating an improved  
electric drive device, namely an improved transverse flow motor.

This problem is solved by an electric drive device ~~in accordance with~~  
30 ~~patent Claim 1.~~ as described within the specification and claims.

Preferred refinements of the invention emerge from the specification and

5 ~~claims from the dependent claims and the following description. A design of the invention is explained on the basis of the drawing, without being restricted to this, wherein:~~

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1: Illustrates a schematized representation of an electric drive device  
10 according to the state of the art in a partially broken up, perspective side view,

Fig. 2: Illustrates a detail of the electric drive device according to the state of the art in accordance with Fig. 1, likewise in perspective side view,

Fig. 3: A strongly schematized representation of an electric drive device within  
15 the sense of the invention with a compressor blade fastened on a rotor of the electric drive device, ~~and~~

Fig. 4: A strongly schematized representation of a rotor of the electric drive device of the invention.

#### DETAILED DESCRIPTION OF THE INVENTION

20 Fig. 1 shows an electric drive device according to the state of the art constructed as a transverse flow motor 10. The transverse flow motor 10 illustrated there includes a cylindrically constructed stator 11 and a cylindrically constructed rotor 12, whereby the rotor 12 is arranged outside the stator 11. In other words, the outer rotor 12 surrounds the internal stator 11. An object 13 to  
25 be driven by the transverse flow motor 10, e.g., ~~for [example]~~ a wheel or a turbine blade, is directly connected with the rotor 12.

Three phases 14, 15 and 16 are arranged alongside one another in the transverse flow motor 10 represented in Figure 1 so that a (not represented) converter can be used for three phase current.

30 Figure 2 clarifies the operating principle underlying the transverse flow motor 10 on the example of phase 14, 15 or 16. The magnetic flow is visualized



5 by flow lines. Thus Figure 2 depicts one of phases 14, 15 or 16 consisting of rotor 12 and stator 11. The stator 11 encloses several U-shaped constructed stator blades 17 arranged at a distance from one another, whereby the stator blades 17 are surrounded by current-carrying windings 18, or surround such. The stator blades 17 of each phase 14, 15 and 16 form a cylindrical ring (see Figure 1).

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20 Furthermore, in accordance with Figure 2, respectively one permanent magnet 19, 20 with likewise alternating polarity is also allocated to the two opposed pole ends 21, 22 of a single stator blade 17. From this it follows first that two adjacent permanent magnets 19, 20 of rotor element 23 or 24 have a different polarity within a single rotor element 23 or 24 which extends in the  
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5 construction principle.

As can be inferred from Fig. 1 in particular, the hollow space between adjacent stator blades 17 is filled by segments 26 of non-magnetic material, on the one hand to obtain a stable construction, and on the other not to impair the magnetic flow. The segments 26 project radially out of a likewise non-magnetic  
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to persons skilled in the art, the invention should be construed to include  
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